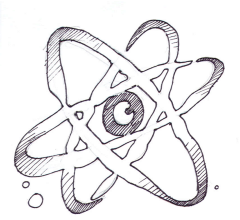
Chemistry Curriculum Map
WRHS Science Department
November 2011



Developed by:

Christina Ansell
Richard Herbst
Jillian Richards

This course is a study of chemistry as an experimental science for the college bound student. Major concepts such as atomic structure, bonding, reactions, gases, and acids/bases are covered. Course work as well as laboratory work will be performed to reinforce key concepts to better the students' understanding. Over the course of the year, skills and techniques in handling materials, apparatus, and concepts will be developed. This course covers the basic principles of the makeup and transformation of substances. Emphasis is on the development of chemical concepts with the equations and calculations necessary for their understanding.

Term 1

Unit 1 Introduction to Chemistry and Matter

Chapter 1- Matter and Change
Chapter 2- Measurement and Calculations

Term 1-2

Unit 2 Organization of Matter

Chapter 3 - Atoms: The Building Blocks of Matter
Chapter 4 - Arrangement of Electrons in Atoms
Chapter 5 - The Periodic Law
Chapter 6 - Chemical Bonding

Term 3

Unit 3 Language of Chemistry

Chapter 7 - Chemical Formulas and Chemical Compounds
Chapter 8 - Chemical Equation and Reactions
Chapter 9 - Stoichiometry

Term 4

Unit 4 Phases of Matter

Chapter 10 - Physical Characteristics
Chapter 11 - Molecular Geometry
Chapter 12 - Liquids and Solids

Term 4

Unit 5 Solutions and Their Behavior

Chapter 13 - Solutions
Chapter 14 - Ions in Aqueous Solutions and Colligative Properties
Chapter 15 - Acids and Bases
Chapter 16 - Acids-Base Titration and pH

Unit 6 Chemical Reactions and Nuclear Chemistry

Chapter 17 - Reaction Energy and Reaction Kinetics
Chapter 18 - Chemical Equilibrium
Chapter 19 - Oxidation-Reduction Reactions
Chapter 22 - Nuclear Chemistry

Unit 1: Introduction to Chemistry and Matter

When will this be taught? Term 1

What are the Essential Questions for this unit?

Is everything in life composed of just three basic units of matter?
How is mathematics used in chemistry?

What State Framework standards will be addressed in this unit?

1.1 Identify and explain physical properties (e.g., density, melting point, boiling point, conductivity, malleability) and chemical properties (e.g., the ability to form new substances). Distinguish between chemical and physical changes.

1.2 Explain the difference between pure substances (elements and compounds) and mixtures. Differentiate between heterogeneous and homogeneous mixtures.

1.3 Describe the three normal states of matter (solid, liquid, gas) in terms of energy, particle motion, and phase transitions.

3.2 Use the periodic table to identify the three classes of elements: metals, nonmetals, and metalloids.

What are the Key Concepts and Factual Information that all Wachusett students will learn in this unit?

Chemistry is a Physical Science
Matter and its Properties
Elements
Scientific Method
Units of Measurement
Scientific Measurements
Lab Safety

What science skills will students utilize in this unit?

- Define chemistry.
- List examples of the branches of chemistry.
- Compare and contrast basic research, applied research, and technological development.
- Distinguish between the physical properties and chemical properties of matter.
- Classify changes of matter as physical or chemical.
- Explain the gas, liquid, and solid states in terms of particles.
- Distinguish between a mixture and a pure substance.
- Use a periodic table to name elements, given their symbols.
- Use a periodic table to write the symbols of elements, given their names.
- Describe the arrangement of the periodic table.
- List the characteristics that distinguish metals, nonmetals, and metalloids.
- Describe the purpose of the scientific method.

- Distinguish between qualitative and quantitative observations.
- Describe the differences between hypotheses, theories, and models.
- Distinguish between a quantity, a unit, and a measurement standard.
- Name SI units for length, mass, time, volume, and density.
- Distinguish between mass and weight.
- Perform density calculations.
- Transform a statement of equality to a conversion factor.
- Distinguish between accuracy and precision.
- Determine the number of significant figures in measurements.*
- Perform mathematical operations involving significant figures.*
- Convert measurements into scientific notation.
- Distinguish between inversely and directly proportional relationships.

* Not covered at CP level Chemistry

What Labs, Activities and Assessments can be utilized in teaching this unit?

Labs & Activities:

- Lab Safety
- Introduction to Lab Equipment
- Separation of a Mixture#
- Physical and Chemical Changes
- Density#
- Measuring the Temperature of a Bunsen Burner Flame
- Law of Conservation of Mass

Required Labs

Demos:

- Hot dog in sulfuric acid
- Separate Iron from cereal
- Chromatography
- Nitric acid and a penny
- Accuracy and Precision

What are possible supports for College Prep-level classes for this unit?

- Model writing lab reports
- Supplemental practice problems
- Solve sample problems
- Provide class notes
- Math skill application support
- Use CPS (clicker) student response technology for formative assessment
- Use of MIMIO technology for screen-capture of classroom instruction
- On-line tutorials and interactive states

What extensions can be used in the Honors-level classes for this unit?

Specific Heat calculations

Which School-Wide Rubrics can be used to determine mastery of concepts in this unit?

Innovation: Developing lab procedures
Written Communication: Lab reports, quizzes, homework, tests, projects
Oral Communication: Class discussions, data analysis presentation
Critical Thinking: Analyzing laboratory data
Problem Solving: Drawing general conclusions from laboratory data to answer questions
Responsibility: Correct use of lab equipment, follow lab safety procedures

Unit 2: Organization of Matter

When will this be taught? Term 1 and Term 2

What are the Essential Questions for this unit?

Is there a pattern that can be used to predict properties of materials yet unknown?

How do atoms combine to form so many different things?

What State Framework standards will be addressed in this unit?

- 2.1 Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.
- 2.2 Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.
- 2.3 Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.
- 2.4 Write the electron configurations for the first twenty elements of the periodic table.
- 2.5 Identify the three main types of radioactive decay (alpha, beta, and gamma) and compare their properties (composition, mass, charge, and penetrating power).
- 3.1 Explain the relationship of an element's position on the periodic table to its atomic number. Identify families (groups) and periods on the periodic table.
- 3.3 Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.
- 3.4 Identify trends on the periodic table (ionization energy, electronegativity, and relative sizes of atoms and ions).
- 4.1 Explain how atoms combine to form compounds through both ionic and covalent bonding. Predict chemical formulas based on the number of valence electrons.
- 4.2 Draw Lewis dot structures for simple molecules and ionic compounds.
- 4.3 Use electronegativity to explain the difference between polar and nonpolar covalent bonds.
- 4.4 Use valence-shell electron-pair repulsion theory (VSEPR) to predict the molecular geometry (linear, trigonal planar, and tetrahedral) of simple molecules.
- 4.5 Identify how hydrogen bonding in water affects a variety of physical, chemical, and biological phenomena (e.g., surface tension, capillary action, density, boiling point).
- 5.3 Use the mole concept to determine number of particles and molar mass for elements and compounds.

What are the Key Concepts and Factual Information that all Wachusett students will learn in this unit?

Discovery of the Atom
Structure of the Atom
Counting Atoms and the Mole
Quantum Model of the Atom
Electron Configurations
History of the Periodic Table
Patterns of Electron Configurations in the Periodic Table
Periodic Trends
Chemical Bonding
Covalent Bonds and Molecular Compounds
Ionic Bonding and Ionic Compounds
Metallic Bonding
Molecular Geometry

What science skills will students utilize in this unit?

- Explain the law of conservation of mass, the law of definite proportions, and the law of multiple proportions.
- Summarize the five essential points of Dalton's atomic theory.
- Explain the relationship between Dalton's atomic theory and the law of conservation of mass, the law of definite proportions, and the law of multiple proportions.
- Summarize the observed properties of cathode rays that led to the discovery of the electron.
- Summarize the experiment carried out by Rutherford and his co-workers that led to the discovery of the nucleus.
- List the properties of protons, neutrons, and electrons.
- Define atom.
- Explain what isotopes are.
- Define atomic number and mass number, and describe how they apply to isotopes.
- Given the identity of a nuclide, determine its number of protons, neutrons, and electrons.
- Define mole in terms of Avogadro's number, and define molar mass.
- Solve problems involving mass in grams, amount in moles, and number of atoms of an element.
- Explain the mathematical relationship between the speed, wavelength, and frequency of electromagnetic radiation.
- Discuss the dual wave-particle nature of light.
- Discuss the significance of the photoelectric effect and the line-emission spectrum of hydrogen to the development of the atomic model.
- Describe the Bohr model of the hydrogen atom.
- Discuss Louis de Broglie's role in the development of the quantum model of the atom.

- Compare and contrast the Bohr model and the quantum model of the atom.
- Explain how the Heisenberg uncertainty principle and the Schrödinger wave equation led to the idea of atomic orbitals.
- List the four quantum numbers, and describe their significance.
- Relate the number of sublevels corresponding to each of an atom's main energy levels, the number of orbitals per sublevel, and the number of orbitals per main energy level.
- List the total number of electrons needed to fully occupy each main energy level.
- State the Aufbau principle, the Pauli exclusion principle, and Hund's rule.
- Describe the electron configurations for the atoms of any element using orbital notation, electron-configuration notation, and, when appropriate, noble-gas notation.
- Explain the roles of Mendeleev and Moseley in the Development of the Periodic Table
- Describe the modern periodic table
- Explain how the periodic law can be used to predict the physical and chemical properties of elements
- Describe how the elements belonging to a group of the periodic table are interrelated in terms of atomic number
- Describe the relationship between electrons in sublevels and the length of each period of the periodic table
- Locate and name the four blocks of the periodic table. Explain the reasons for these names
- Discuss the relationships between group configurations and group numbers
- Describe the locations in the periodic table and the general properties of the alkali metals, the alkaline earth metals, the halogens, and the noble gases
- Define atomic and ionic radii, ionization energy, electron affinity*, and electronegativity.
- Compare the periodic trends of atomic radii, ionization energy, and electronegativity and state the reasons for these variations.
- Define valence electrons, and state how many are present in atoms of each main-group element
- Compare the of atomic radii, ionization energy, and electronegativities of the d-block elements with those of the main-group elements*
- Define Chemical Bond
- Explain why most atoms form chemical bonds
- Describe ionic and covalent bonding.
- Explain why most chemical bonding is neither purely ionic nor purely covalent
- Classify bonding type according to electronegativity differences
- Define molecule and molecular formula
- Explain the relationships between potential energy, distance between approaching atoms, bond length, and bond energy
- State the octet rule
- List the six basic steps used in writing Lewis Structures.
- Explain how to determine Lewis Structures for molecules containing single

bonds, multiple bonds, or both.
- Explain why scientists use resonance structures to represent some molecules
- Compare and contrast a chemical formula for a molecular compound with one for an ionic compound
- Discuss the arrangements of ions in crystals
- Define lattice energy and explain its significance
- List and compare the distinctive properties of ionic and molecular compounds
- Write the Lewis structure fro a polyatomic ion given the identity of the atoms combined and other appropriate information
- Describe the electrons-sea model of metallic bonding and explain why metals are good electrical conductors.
- Explain why metal surfaces are shiny.
- Explain why metals are malleable and ductile but ionic-crystalline compounds are not.
- Explain VSEPR theory.
- Predict the shape of molecules of polyatomic ions using VSEPR theory.
- Describe dipole-dipole forces, hydrogen bonding, induced dipoles, and London dispersion.
- Explain what determines molecular polarity.

* Not covered at CP level Chemistry

What Labs, Activities and Assessments can be utilized in teaching this unit?

Labs & Activities:

Evidence of Chemical Change
Molar Mass of Noodlium
How Much is a Mole?
Flame Test#
Periodic Properties#
Atomic Radius graphing activity
Ionization Energy graphing activity
Periodic Trends of density, melting point and boiling point graphing activity
Metal Reactivity
Iron Ions#
Qualitative Analysis#
Molecular Modeling
Intermolecular Forces

Required Labs

Demos:

Cathode ray tube
Spectroscope, bright line spectrum

Floating a paperclip on water
Braniac Alkali metals video
Alkaline Earth Metals in Water
VSEPR Balloon Models

What are possible supports for College Prep-level classes for this unit?

Model writing lab reports
Supplemental practice problems
Solve sample problems
Provide class notes
Math skill application support
Use CPS (clicker) student response technology for formative assessment
Use of MIMIO technology for screen-capture of classroom instruction
On-line tutorials and interactive states

What extensions can be used in the Honors-level classes for this unit?

Which School-Wide Rubrics can be used to determine mastery of concepts in this unit?

Innovation: Developing lab procedures
Written Communication: Lab reports, quizzes, homework, tests, projects
Oral Communication: Class discussions, data analysis presentation
Critical Thinking: Analysing laboratory data
Problem Solving: Drawing general conclusions from laboratory data to answer questions
Responsibility: Correct use of lab equipment, follow lab safety procedures

Unit 3: Language of Chemistry

When will this be taught? Term 3

What are the Essential Questions for this unit?

How are chemical compounds named?
Is it really true that you cannot create or destroy matter?
What affects the rates of chemical reactions?

What State Framework standards will be addressed in this unit?

- 4.6 Name and write the chemical formulas for simple ionic and molecular compounds, including those that contain the polyatomic ions: ammonium, carbonate, hydroxide, nitrate, phosphate, and sulfate
- 5.1 Balance chemical equations by applying the laws of conservation of mass and constant composition (definite proportions).
- 5.2 Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
- 5.4 Determine percent compositions, empirical formulas, and molecular formulas.
- 5.5 Calculate the mass-to-mass stoichiometry for a chemical reaction.
- 5.6 Calculate percent yield in a chemical reaction.
- 6.4 Describe the law of conservation of energy. Explain the difference between an endothermic process and an exothermic process.
- 8.4 Describe oxidation and reduction reactions and give some everyday examples, such as fuel burning and corrosion. Assign oxidation numbers in a reaction.

What are the Key Concepts and Factual Information that all Wachusett students will learn in this unit?

Chemical Names and Formulas
Oxidation Numbers*
Mathematics with Chemical Formulas
Determining Chemical Formulas
Describing Chemical Reactions
Types of Chemical Reactions
Activity Series of Elements
Stoichiometry
Limiting Reactants*
Percent Yield

* Not covered at CP level Chemistry

What science skills will students utilize in this unit?

- Explain the significance of a chemical formula.

- Determine the formula of an ionic compound formed between two given ions.
- Name an ionic compound given its formula.
- Using prefixes, name a binary molecular compound from its formula.
- Write the formula of a binary molecular compound given its name.
- List the rules for assigning oxidation numbers.*
- Give the oxidation number for each element in the formula of a chemical compound.
- Name the binary molecular compounds using oxidation numbers and the Stock system.
- Calculate the formula mass or molar mass of any given compound.
- Use molar mass to convert between mass in grams and amount of moles in a compound.
- Calculate the number of molecules, formula units, or ions in a given molar amount of a chemical compound.
- Calculate the percent composition of a given chemical compound.
- Define empirical formula, and explain how the term applies to ionic and molecular compounds.
- Determine an empirical formula from either a percent composition or a mass composition.*
- Explain the relationship between the empirical formula and the molecular formula of a given compound
- Determine the molecular formula from an empirical formula.*
- List three observations that suggest a chemical reaction has taken place.
- List three requirements for a correctly written chemical equation.
- Write a word equation and a formula equation for a given chemical reaction.
- Balance a formula equation by inspection.
- Define and give general equations for synthesis, decomposition, single-replacement, and double-replacement reactions.
- Classify a reaction as synthesis, decomposition, single-replacement, double-replacement or combustion.
- List three types of synthesis reactions and 6 types of decompositions reaction.
- List four types of single-replacement reactions and 3 types of double-displacements reactions.
- Predict the products of simple reactions given the reactants.*
- Explain the significance of an activity series.
- Use an activity series to predict whether a given reaction will occur and what the products will be.*
- Define stoichiometry.
- Describe the importance of the mole ratio in stoichiometry calculations.
- Write a mole ratio relating two substances in a chemical equation.
- Calculate the amount in moles of the reactant or product from the amount in moles of a different reactant or product.
- Calculate the amount in mass of the reactant or product from the amount in moles of a different reactant or product.
- Calculate the amount in moles of the reactant or product from the amount in mass of a different reactant or product.

- Calculate the amount in mass of the reactant or product from the amount in mass of a different reactant or product.
- Describe a method for determining which of two reactants is a limiting reactant.*
- Calculate the amount in moles or mass in grams of a product, given the amounts in moles or masses in grams of 2 reactants, one of which is in excess.*
- Distinguish between theoretical yield, actual yield, and percent yield.
- Calculate percent yield, given the actual yield and quantity of a reactant.

* Not covered at CP level Chemistry

What Labs, Activities and Assessments can be utilized in teaching this unit?

Labs:

Composition of a Hydrate#
Calculating the number of moles of a burning candle
Indications of Chemical Reactions
Single Replacement Reactions
Double Replacement Reactions
Types of Chemical Reactions#
Stoichiometry
Stoichiometry Percent yield
Stoichiometry Limiting reactant
Stoichiometry Theoretical yield
Alka seltzer

Required Labs

Demos:

$MnO_2 + H_2O_2$ vs $MnO_2 + H_2O$
Synthesis Reaction: Magnesium Oxide
Decomposition Reaction: hydrolysis of water , Dehydration of Sugar
Single Replacement: Zn +HCl, Cu + $AgNO_3$, Al + $CuNO_3$
Double Replacement: Rainbow
Combustion: Combustion of Butane / Methane bubbles
- Explosion of Hydrogen Balloon
Limiting Reactant Demo: Gas Production
Elephant toothpaste: H_2O_2 + KI + soap + food coloring

What are possible supports for College Prep-level classes for this unit?

Model writing lab reports
Supplemental practice problems
Solve sample problems
Provide class notes
Math skill application support

Use CPS (clicker) student response technology for formative assessment
Use of MIMIO technology for screen-capture of classroom instruction
On-line tutorials and interactive states

What extensions can be used in the Honors-level classes for this unit?

Oxidation Numbers

Which School-Wide Rubrics can be used to determine mastery of concepts in this unit?

Innovation: Developing lab procedures
Written Communication: Lab reports, quizzes, homework, tests, projects
Oral Communication: Class discussions, data analysis presentation
Critical Thinking: Analyzing laboratory data
Problem Solving: Drawing general conclusions from laboratory data to answer questions
Responsibility: Correct use of lab equipment, follow lab safety procedures

Unit 4: Phases of Matter

When will this be taught? Term 4

What are the Essential Questions for this unit?

What properties distinguish the three states of matter?

Why does the volume occupied by a gas or the pressure exerted by a gas not always remain constant?

What State Framework standards will be addressed in this unit?

6.1 Using the kinetic molecular theory, explain the behavior of gases and the relationship between pressure and volume (Boyle's law), volume and temperature (Charles's law), pressure and temperature (Gay-Lussac's law), and the number of particles in a gas sample (Avogadro's hypothesis). Use the combined gas law to determine changes in pressure, volume, and temperature.

6.2 Perform calculations using the ideal gas law. Understand the molar volume at 273 K and 1 atmosphere (STP).

6.3 Using the kinetic molecular theory, describe and contrast the properties of gases, liquids, and solids. Explain, at the molecular level, the behavior of matter as it undergoes phase transitions.

What are the Key Concepts and Factual Information that all Wachusett students will learn in this unit?

Kinetic-Molecular Theory
Pressure
Gas Laws
Volume-Mass Relationships of Gases
Ideal Gas Law
Stoichiometry of Gases
Effusion*
Diffusion
Liquids
Solids
Changes of State
Water

* Not covered at CP level Chemistry

What science skills will students utilize in this unit?

- State the kinetic-molecular theory of matter, and describe how it explains certain properties of matter.
- List the five assumptions of the kinetic molecular theory.
- Describe each of the following characteristics property.
- Describe the condition under which a real gas deviates from "ideal".
- Define pressure and relate it to force.

- Describe how pressure is measured.
- Convert units of pressure.
- State the standard conditions of temperature and pressure.
- Use the kinetic-molecular theory to explain the relationships between gas volume, temperature, and pressure.
- Use Boyle's Law to calculate volume-pressure changes at constant temperature.
- Use Charles's Law to calculate volume-temperature changes at constant pressure.
- Use Gay-Lussac's Law to calculate pressure-temperature changes at constant volume.
- Use the Combined Gas Law to calculate pressure-temperature-volume changes.
- Use Dalton's Law of partial pressure to calculate partial pressures and total pressures.
- State the law of combining volumes.
- State Avogadro's Law and explain its significance.
- Define Standard Molar Volume of a Gas, and use it to calculate gas masses and volume.
- Use standard molar volume to calculate the molar mass of a gas.
- State the ideal gas law.
- Derive the ideal gas constant and discuss its units.
- Using the ideal gas law, calculate pressure, volume, temperature, or amount of gas when the other three quantities are known.
- Using the ideal gas law, calculate the molar mass or density of a gas.
- Reduce the ideal law to Boyle's law, Charles's Law, and Avogadro's Law. Describe the conditions under which each applies.
- Explain how Gay-Lussac's Law and Avogadro's Law apply to the volumes of gases in chemical reactions.
- Use a chemical equation to specify volume ratios for gaseous reactants or products, or both.
- Use volume ratios and the gas laws to calculate volumes, masses, or molar amounts of gaseous reactants or products.
- State Graham's Law of Effusion.*
- Determine the relative rates of effusion of two gases of known molar masses.*
- State the relationship between the molecular velocities of two gases and their molar masses.*
- Describe the motion of particles in solids and liquids according to Kinetic Molecular Theory.
- Define vaporization, freezing, boiling, sublimation, crystal structure, unit cell, and equilibrium.
- Distinguish between two types of solids.
- Predict changes in equilibrium based on Le Chatelier's Principle.*
- Interpret phase diagrams.

* Not covered at CP level Chemistry

What Labs, Activities and Assessments can be utilized in teaching this unit?

Labs:

- Properties of Gases
- Boyle's Law
- Molar Volume[#]
- Molar Mass of Butane[#]

[#] Required Labs

Demos:

- Student in a trash bag
- Crushing a soda can
- Making water boil twice
- Gay-Lussac - balloon inverted in a Erlenmeyer flask
- Marshmallow in a vacuum / syringe
- Balloon in a vacuum / syringe
- Triple point of H_2O
- Boiling H_2O at room temperature with use of vacuum / syringe
- Milk in water - Tyndall effect

What are possible supports for College Prep-level classes for this unit?

- Model writing lab reports
- Supplemental practice problems
- Solve sample problems
- Provide class notes
- Math skill application support
- Use CPS (clicker) student response technology for formative assessment
- Use of MIMIO technology for screen-capture of classroom instruction
- On-line tutorials and interactive states

What extensions can be used in the Honors-level classes for this unit?

Which School-Wide Rubrics can be used to determine mastery of concepts in this unit?

- *Innovation:* Developing lab procedures
- *Written Communication:* Lab reports, quizzes, homework, tests, projects
- *Oral Communication:* Class discussions, data analysis presentation
- *Critical Thinking:* Analyzing laboratory data
- *Problem Solving:* Drawing general conclusions from laboratory data to answer questions
- *Responsibility:* Correct use of lab equipment, follow lab safety procedures

Unit 5: Solutions and Their Behavior

When will this be taught? Term 4

What are the Essential Questions for this unit?

How do you know what a solution is?
How are acids and bases really important in our life and in our environment?

What State Framework standards will be addressed in this unit?

7.1 Describe the process by which solutes dissolve in solvents.
7.2 Calculate concentration in terms of molarity. Use molarity to perform solution dilution and solution stoichiometry.
7.3 Identify and explain the factors that affect the rate of dissolving (e.g., temperature, concentration, surface area, pressure, mixing).
7.4 Compare and contrast qualitatively the properties of solutions and pure solvents (colligative properties such as boiling point and freezing point).
7.5 Identify the factors that affect the rate of a chemical reaction (temperature, mixing, concentration, particle size, surface area, catalyst).
7.6 Predict the shift in equilibrium when a system is subjected to a stress (LeChatelier's principle) and identify the factors that can cause a shift in equilibrium (concentration, pressure, volume, temperature).
8.1 Define the Arrhenius theory of acids and bases in terms of the presence of hydronium and hydroxide ions in water and the Bronsted-Lowry theory of acids and bases in terms of proton donors and acceptors.
8.2 Relate hydrogen ion concentrations to the pH scale and to acidic, basic, and neutral solutions. Compare and contrast the strengths of various common acids and bases (e.g., vinegar, baking soda, soap, citrus juice).
8.3 Explain how a buffer works.

What are the Key Concepts and Factual Information that all Wachusett students will learn in this unit?

Types of Mixtures
Solvation
Concentration of Solutions
Aqueous Solutions
Colligative Properties
Properties of Acids and Bases
Acid-Base Theories
Acid-Base Reactions
pH
Titrations

What science skills will students utilize in this unit?

- Distinguish between heterogeneous and homogeneous mixtures.
- Define solute and solvent.
- Compare colloids, suspensions, and solutions.
- Distinguish between saturated, unsaturated and supersaturated solutions.
- Explain meaning of “like dissolves like”.
- Use the concept of molarity and molality to solve a variety of problems.
- Define dissociation.
- Predict whether a precipitate will form based on solubilities.
- Write net ionic equations.*
- List 4 colligative properties and explain why they are classified as such.
- Distinguish between acids and bases based on their properties.
- Define acid and base, conjugate acid and conjugate base.
- Explain concept of strong acids and bases.
- Explain the process of neutralization.
- Define pH.
- Explain and use the pH scale.
- Use titration as a method to determine the molarity of acids and bases.

* Not covered at CP level Chemistry

What Labs, Activities and Assessments can be utilized in teaching this unit?

Labs & Activities:

- Rate of Dissolution
- Solubility of Potassium Nitrate#
- Titration#
- Titration of an Antacid
- pH
- Acid Base Properties

Required Labs

Demos:

Required Labs

What are possible supports for College Prep-level classes for this unit?

- Model writing lab reports
- Supplemental practice problems
- Solve sample problems
- Provide class notes
- Math skill application support
- Use CPS (clicker) student response technology for formative assessment

Use of MIMIO technology for screen-capture of classroom instruction
On-line tutorials and interactive states

What extensions can be used in the Honors-level classes for this unit?

Which School-Wide Rubrics can be used to determine mastery of concepts in this unit?

Innovation: Developing lab procedures
Written Communication: Lab reports, quizzes, homework, tests, projects
Oral Communication: Class discussions, data analysis presentation
Critical Thinking: Analyzing laboratory data
Problem Solving: Drawing general conclusions from laboratory data to answer questions
Responsibility: Correct use of lab equipment, follow lab safety procedures

Unit 6: Chemical Reactions and Nuclear Chemistry (Honors Only)

When will this be taught? Term 4

What are the Essential Questions for this unit?

How do various factors affect how chemical reactions proceed?

How are nuclear reactions important to society?

What State Framework standards will be addressed in this unit?

2.6 Describe the process of radioactive decay by using nuclear equations, and explain the concept of half-life for an isotope (for example, C-14 is a powerful tool in determining the age of objects).

2.7 Compare and contrast nuclear fission and nuclear fusion.

6.4 Describe the law of conservation of energy. Explain the difference between an endothermic process and an exothermic process.

6.5 Recognize that there is a natural tendency for systems to move in a direction of disorder or randomness (entropy).

8.4 Describe oxidation and reduction reactions and give some everyday examples, such as fuel burning and corrosion. Assign oxidation numbers in a reaction.

What are the Key Concepts and Factual Information that all Wachusett students will learn

Thermochemistry
Driving Forces of Reactions
Reaction Process
Reaction Rates
Chemical Equilibrium
Shifting Equilibrium
Equilibria of Acids, Bases, and Salts
Solubility Equilibrium
Oxidation and Reduction
Balancing Redox Reactions
Oxidizing and Reducing Agents
Electrochemistry
The Nucleus
Radioactive Decay
Nuclear Radiation
Nuclear Fission
Nuclear Fusion

What science skills will students utilize in this unit?

- Define temperature and heat and the units used.
- Perform specific-heat calculations

- Solve problems involving heats of reaction, heats of formation, and heats of combustion.
- Define chemical equilibrium.
- Explain the nature of the equilibrium constant.
- Write chemical equilibrium expressions and carry out calculations involving them.
- Describe the use of free energy change to determine the tendency of a reaction to occur.
- Explain the concept of reaction mechanism and use the collision theory to interpret chemical reactions.
- Write chemical equilibrium expressions and carry out calculations involving them.

- Explain why nuclear reactions occur, and know how to balance a nuclear equation.
- Define and relate the terms radioactive decay and nuclear radiation
- Describe the different types of radioactive decay and their effects on the nucleus
- Define the term half-life, and explain how it relates to the stability of a nucleus
- Compare the penetrating ability and shielding requirements of alpha particles, beta particles, and gamma rays.
- Discuss applications of radioactive nuclides.

What Labs, Activities and Assessments can be utilized in teaching this unit?

Chromatography
Synthesis of Sodium Chloride

What are possible supports for College Prep-level classes for this unit?

Model writing lab reports
Supplemental practice problems
Solve sample problems
Provide class notes
Math skill application support
Use CPS (clicker) student response technology for formative assessment
Use of MIMIO technology for screen-capture of classroom instruction
On-line tutorials and interactive states

What extensions can be used in the Honors-level classes for this unit?

Which School-Wide Rubrics can be used to determine mastery of concepts in this unit?

Innovation: Developing lab procedures
Written Communication: Lab reports, quizzes, homework, tests, projects

Oral Communication: Class discussions, data analysis presentation
Critical Thinking: Analyzing laboratory data
Problem Solving: Drawing general conclusions from laboratory data to answer questions
Responsibility: Correct use of lab equipment, follow lab safety procedures

What Common Core Standards will be addressed in this Course?

Reading Standards in Science Gr. 11-12

Key Ideas and Details

1. Cite specific textual evidence to support lab hypothesis
2. Determine the central ideas of textbook readings and summarize key concepts
3. Follow a complex lab procedure

Craft and Structure

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in Labs and Chemistry texts.
5. Relate a laboratory introduction to the related classroom topic.
6. Interpret a lab procedure in order to create a data table.

Integration of Knowledge and Ideas

7. Perform research for a presentation. Complete complex word problems
8. Predict outcomes of in-class demonstrations. Synthesize own laboratory procedures based on purpose of the experiment.
9. Compare and contrast lab results. Identify potential errors in results/procedure.

Range of Reading and Level of Text Complexity

10. Read and interpret textbook and scientific articles of appropriate grade level.

Writing Standards in Science Gr. 11-12

Text Type and Purposes

1a-e. Write formal lab reports using passive voice and scientific/academic vocabulary. Support hypothesis with details. Write a conclusion using relevant results from the experiment.

2a-e. Write formal lab reports in an organized and logical manner using scientific vocabulary. Present data and results in graphs and tables. Write a conclusion using relevant results from the experiment to support ideas.

3. Not applicable

4.Write formal lab reports in an organized and logical manner using scientific vocabulary. Present data and results in graphs and tables.

Write a conclusion using relevant results from the experiment to support ideas.

5. Complete limited sections for the majority of lab reports in order to fine tune writing skills for the more inclusive formal labs.
6. Utilize Microsoft Office (Word, Powerpoint, and Excel), GoogleApps(Sites and Docs) and Wikispaces to complete and share assignments.

Research to Build and Present Knowledge

7. Perform year-long research project. (Honors Level only, CPA and CP levels need improvement in this area)
8. Perform year-long research project. (Honors Level only, CPA and CP levels need improvement in this area)
9. Perform year-long research project. (Honors Level only, CPA and CP levels need improvement in this area)

Range of Writing

10. Perform year-long research project. (Honors Level only, CPA and CP levels need improvement in this area)

What State Inquiry Skills Standards will be addressed in this Course?

SIS1. Make observations, raise questions, and formulate hypotheses.

-Observe the world from a scientific perspective.
-Pose questions and form hypotheses based on personal observations, scientific articles, experiments, and knowledge.
-Read, interpret, and examine the credibility and validity of scientific claims in different sources of information, such as scientific articles, advertisements, or media stories.

SIS2. Design and conduct scientific investigations.

-Articulate and explain the major concepts being investigated and the purpose of an investigation.
-Select required materials, equipment, and conditions for conducting an experiment.
-Identify independent and dependent variables.
-Write procedures that are clear and replicable.
-Employ appropriate methods for accurately and consistently
  - making observations
  - making and recording measurements at appropriate levels of precision
  - collecting data or evidence in an organized way

-Properly use instruments, equipment, and materials (e.g., scales,

probeware, meter sticks, microscopes, computers) including set-up, calibration (if required), technique, maintenance, and storage.

-Follow safety guidelines.

SIS3. Analyze and interpret results of scientific investigations.

-Present relationships between and among variables in appropriate forms.

- Represent data and relationships between and among variables in charts and graphs.
- Use appropriate technology (e.g., graphing software) and other tools.

-Use mathematical operations to analyze and interpret data results.

-Assess the reliability of data and identify reasons for inconsistent results, such as sources of error or uncontrolled conditions.

-Use results of an experiment to develop a conclusion to an investigation that addresses the initial questions and supports or refutes the stated hypothesis.

-State questions raised by an experiment that may require further investigation.

SIS4. Communicate and apply the results of scientific investigations.

-Develop descriptions of and explanations for scientific concepts that were a focus of one or more investigations.

-Review information, explain statistical analysis, and summarize data collected and analyzed as the result of an investigation.

-Explain diagrams and charts that represent relationships of variables.

-Construct a reasoned argument and respond appropriately to critical comments and questions.

-Use language and vocabulary appropriately, speak clearly and logically, and use appropriate technology (e.g., presentation software) and other tools to present findings.

-Use and refine scientific models that simulate physical processes or phenomena.